(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 October 2002 (31.10.2002)

PCT

(10) International Publication Number
WO 02/087285 A1

(51) International Patent Classification⁷: H05B 6/02, 6/10

(21) International Application Number: PCT/IB02/01301

(22) International Filing Date: 17 April 2002 (17.04.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MI01A000835 19 April 2001 (19.04.2001) IT

(71) Applicant and
(72) Inventor: ROSASTRO, Paolo, Arnaldo [IT/IT]; Via Don Folli, 65, I-21016 Luino (IT).

(74) Agent: FIAMMENGHI-DOMENIGHETTI, Delfina; Fiammenghi-Fiammenghi, Via San Gottardo, 15, CH-6900 Lugano (CH).

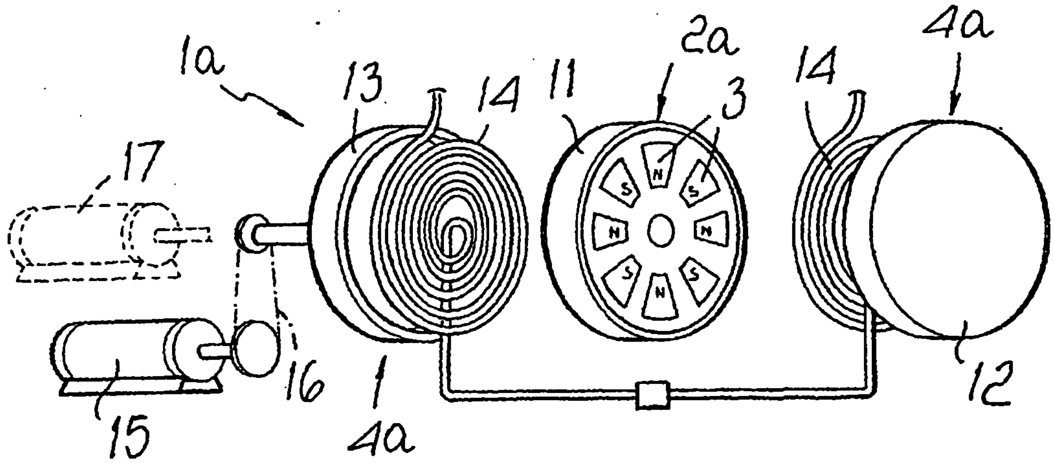
(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DEVICE FOR CONVERTING MAGNETIC ENERGY INTO THERMAL ENERGY, PARTICULARLY FOR HEATING MATERIAL IN A SOLID OR FLUID STATE



(57) Abstract: The present invention relates to a device for converting magnetic energy into thermal energy, particularly for heating material in a solid or fluid state. The device comprises at least one first ferromagnetic element bearing a plurality of high-energy permanent magnets and at least one second element made of an electrically conducting material facing the first element. The device comprises drive means for imparting a movement to the first element relative to the second element or vice versa. The high-energy permanent magnets exhibit polarities that alternate along the direction of motion of the first element relative to the second element or vice versa. The electric currents induced by the variable magnetic induction flux cutting the second element produce, by the Joule effect, a heating of the second element and the heat produced can be carried away by a heat-transfer fluid or solid, which strikes the second element, and can be used in both residential and industrial applications.

WO 02/087285 A1

BEST AVAILABLE COPY

<u>Device for converting magnetic energy into thermal energy, particularly for heating material in a solid or fluid state</u>

The present invention relates to a device for converting magnetic energy into thermal energy, particularly for heating material in a solid or fluid state.

As is known, in an electrically conducting material cut by a flux of magnetic induction (magnetic flux) that varies in time, electric currents known as Foucault currents or eddy currents are set up by the e.m.f. induced by this flux within the said material.

These currents have many industrial uses, such as induction furnaces, electricity meters, electromagnetic brakes, and techniques of welding or tinning.

The chief object of the present invention is to provide a device that will apply the above theory in order to convert, in a simple and economically advantageous manner, magnetic energy into thermal energy which can then be put to use for many applications, both residential and industrial.

Within the scope of this object, one aim of the invention is to propose a device that is simple to construct.

This object, and the above aim along with other aims which will become evident in the course of the text, are achieved with a device for converting magnetic energy into thermal energy, particularly for heating material in a solid or fluid state, characterized in that it comprises at least one first ferromagnetic element bearing a plurality of high-energy permanent magnets and at least one second element made of an electrically conducting material facing the said first element, drive means being provided to impart a movement to the said first element relative to the said second element or vice versa, the

said high-energy permanent magnets having alternating polarities along the direction of motion of the said first element relative to the said second element or vice versa.

Other features and advantages of the invention will become clear in the course of the description of certain preferred, but not exclusive embodiments of the device according to the invention, illustrated by way of non-limiting indication, in the attached drawings, in which:

Figure 1 shows schematically a first embodiment of the device according to the invention, in an exploded perspective view;

Figure 2 shows schematically an enlarged detail from Figure 1 in section;

Figure 3 shows schematically a second embodiment of the device according to the invention, in an exploded perspective view;

Figure 4 shows schematically an enlarged detail from Figure 3 in section;

Figure 5 shows schematically a third embodiment of the device according to the invention, in an exploded perspective view;

Figure 6 shows schematically a fourth embodiment of the device according to the invention, in an exploded perspective view;

Figure 7 shows an alternative embodiment of the first element of the device according to the invention, in perspective and partly in section; and

Figure 8 shows schematically a fifth embodiment of the device according to the invention, in a perspective view.

Referring to the abovementioned figures, the device according to the invention, which is indicated in its various embodiments by reference numbers 1a, 1b, 1c, 1d, comprises at least one first ferromagnetic element 2a, 2b, 2c, 2d which bears a plurality of high-energy permanent magnets 3, and at least one second

element 4a, 4b, 4c, 4d, made of an electrically conducting material, such as metal, facing the first element. The device includes drive means for imparting a movement to the first element 2a, 2b, 2c, 2d relative to the second element 4a, 4b, 4c, 4d, or vice versa. The magnets 3 are arranged in such a way that their polarities alternate along the direction of motion of the first element 2a, 2b, 2c, 2d relative to the second element 4a, 4b, 4c, 4d, or vice versa.

"High-energy permanent magnets" here means permanent magnets exhibiting a magnetic induction greater than or at least equal to 2000 G (gauss), such as the neodymium iron magnets.

In the device according to the invention either the first element 2a, 2b, 2c, 2d or the second element 4a, 4b, 4c, 4d, or both, may be driven in the same or opposite directions, provided that the result is a relative movement of one with respect to the other.

Owing to this relative movement, the second element 4a, 4b, 4c, 4d is cut by a flux of magnetic induction which is variable and induces electric currents in the second element. These induced electric currents produce, by the Joule effect, a heating of the second element 4a, 4b, 4c, 4d and the heat produced can be carried away by a heat-transfer fluid or solid, which strikes the second element, and can be used in both residential and industrial applications.

The motion with which the first and/or the second element is driven is preferably a movement of rotational type.

In the first embodiment, illustrated in Figures 1 and 2, the first element 2a comprises a discoidal body 11 interposed coaxially between two discoidal bodies 12, 13 which belong to the second element 4a. The magnets 3 are mounted on both faces of the discoidal body 11 and are arranged so that their polarities alternate along a circumferential path about the axis of the discoidal body 11.

Alternatively, other than locating magnets 3 on both faces of the discoidal body 11, the discoidal body 11 may contain seats open on both faces of the discoidal body 11, in which the magnets 3 are housed, the magnets thus facing both the discoidal body 12 and the discoidal body 13.

The second element 4a comprises, in addition to the discoidal bodies 12 and 13, means for conveying a heat-transfer fluid or solid, these means preferably consisting of a pipe 14, preferably made of an electrically conducting material, which is formed into a spiral on that face of the discoidal body 12 and of the discoidal body 13 which is next to the discoidal body 11. As an alternative, the pipe 14 may be formed into some other shape, such as linear.

The discoidal body 11 may be driven with rotational motion about its axis by an electric motor 15, or by other drive means of known type, optionally via a transmission 16. Alternatively or in combination it is possible to drive the discoidal bodies 12 and 13, with rotational motion about their axis, by another motor 17. In Figure 2 the discoidal body 11 is shown driven directly by a motor 15 which is connected directly to the discoidal body 11 by its output shaft, while the discoidal bodies 12 and 13 are static.

In the second embodiment, illustrated in Figures 3 and 4, the first element 2b comprises two coaxial discoidal bodies 21 and 22, between which is a coaxial discoidal body 23 belonging to the second element 4b. The magnets 3 are mounted on that face of the discoidal bodies 21 and 22 which is next to the discoidal body 23 and are arranged with alternating polarities along a circumferential path about the axis of the discoidal bodies 21 and 22.

The second element 4b comprises, in addition to the discoidal body 23, means for conveying a heat-transfer fluid or solid, these means preferably consisting of a pipe 24, preferably made of an

electrically conducting material, which is formed into a spiral on both faces of the discoidal body 23.

The discoidal bodies 21 and 22 may be driven with rotational motion about their axis by an electric motor 25, or by other drive means of known type. Alternatively or in combination it is possible to drive the discoidal body 23 with rotational motion about its axis by another motor, not shown for clarity. Figure 4 shows the discoidal bodies 21 and 22 driven directly by a motor 25 which is connected directly to the discoidal bodies 21 and 22 by its output shaft, while the discoidal body 23 is static.

In both the first and second embodiments, the magnets 3 can be arranged, using a plurality of magnets along a radial direction of the corresponding discoidal body, in such a way that there are also alternating polarities when working away from the centre towards the periphery of the corresponding discoidal body.

Obviously, a simplified version of the first and second embodiments would be to make both the first element 2a, 2b and the second element 4a, 4b as two single discoidal bodies each having only one opposing face, with the magnets 3 on one and the pipe 14 or 24 on the other.

In both the first and second embodiments, the functions of the discoidal bodies 12, 13 and 23 may be simply to support the pipe 14, 24, which would thus be the only element in which an e.m.f. was actually induced by the changing magnetic induction flux produced by the relative motion between the first element 2a, 2b and the second element 4a, 4b; or they may be made of an electrically conducting material and be involved in the e.m.f. induction effect. As extreme cases, the second element 4a, 4b could consist of the pipes 14, 24 only, or of the discoidal bodies 12, 13, 23 only. In this latter case, the only function of the pipes 14, 24 would be to carry a heat-transfer fluid into contact with the discoidal bodies 12, 13, 23.

In the third embodiment, shown in Figure 5, the first element 2c comprises a cylindrical body 31 whose side wall is next to the second element 4c, which lies coaxially around the cylindrical body 31. The second element 4c may simply be a pipe 32 made of an electrically conducting material, through which a heat-transfer fluid is fed, and which is arranged in a cylindrical helix, or at any rate a coaxial cylinder, around the side wall of the cylindrical body 31, or else it may be a cylindrical body arranged coaxially around the cylindrical body 31, with the pipe 32 attached to it or formed within it. The magnets 3 are mounted on the side wall of the cylindrical body 31 in such a way as to be next to the second element 4c. These magnets 3 are arranged in such a way that their polarities alternate along a circumferential path about the axis of the cylindrical body 31.

The cylindrical body 31 is preferably hollow and able to be driven with rotational motion about its axis by a motor 33, optionally with a transmission 34. As an alternative or in combination, the pipe 32 or the cylindrical body on which this pipe may be mounted, may be driven with rotational motion about its axis by a motor 35.

In the fourth embodiment, shown in Figure 6, the first element 2d comprises a hollow cylindrical body 41 whose internal side wall is next to the second element 4d, which is arranged coaxially inside the cylindrical body 41. The second element 4d may simply be a pipe made of an electrically conducting material in a cylindrical helix, much as described with reference to the third embodiment, or, as illustrated, may be a hollow cylindrical body 42 made of an electrically conducting material into which a heat-transfer fluid or solid is fed and advanced along the axis of the cylindrical body 42 by known means, e.g. by a screw 43 located coaxially inside the cylindrical body 42 and driven by a motor 44. The cylindrical body

41 may be driven with rotational motion about its axis by a motor 45. Alternatively or in combination, the cylindrical body 42 may be driven with rotational motion about its axis by another motor 46.

In this embodiment the magnets 3 are mounted on the inner side wall of the cylindrical body 41 so as to be next to the second element 4d. These magnets 3 are arranged in such a way that their polarities alternate along a circumferential path about the axis of the cylindrical body 31.

Figure 7 shows an alternative embodiment of the first element in the cylindrical body form. In this alternative embodiment the magnets 3 are arranged in windows defined in the side wall of the cylindrical body 51 of the first element so as to face both into and out away from the cylindrical body 51. In this way, the second element of the device according to the invention may comprise a cylindrical body, or simply a pipe made of an electrically conducting material, which goes inside coaxially with the cylindrical body 51, of the type illustrated in Figures 5 and 6, and a cylindrical body, or simply an electrically conducting pipe, that goes around the outside of and coaxially with the cylindrical body 51. As before, the cylindrical body 51 and/or the inner and outer cylindrical bodies or the pipe, which represent the second element, may be driven with rotational motion about their axis by motors.

In the fifth embodiment, shown in figure 8, the first element 2e comprises a body 61, shaped as a cone or a truncated cone, whose side wall is next to the second element 4e, which is arranged coaxially around the said body 61 shaped as a cone or a truncated cone. The second element 4e may simply be a duct 62 of an electrically conductive material, into which a heat-transfer fluid is fed, arranged as a conical helix, or as a cone or a truncated cone, coaxially positioned around the side wall of the above described body 61, or

may be a member, shaped as a cone or a truncated cone coaxially positioned around the same body 61, on which the duct 62 is mounted or formed. The magnets 3 are fixed on the side wall of the body 61 so as to result opposed to the second element 4e. Said magnets 3 are arranged in such a way that their polarities alternate along a circumferential path around the axis of the body 61 that is shaped as a cone or a truncated cone. The body 61 is able to be driven with rotational motion about its axis by a motor 63, optionally with a transmission 64. As an alternative or in combination, the duct 62 or the body on which this duct may be mounted, may be driven with rotational motion about its axis.

Advantageously, the body 61 that is shaped as a cone or a truncated core is able to be moved along its axis for example by means of a lever, so as to be inserted into or pulled out from the second element 4e. By doing so, it is possible to move the body 61 away from the duct 62 after having heated up the said heat-transfer fluid that circulates across it. As an alternative, it may be foreseen to move the duct 62, or the body on which it is mounted or formed, with respect to the body 61 that is shaped as a cone or a truncated cone.

In the embodiments illustrated in Figures 5 to 8, the magnets 3 may consist of parts that follow each other either circumferentially, with alternating polarities, about the axis of the body on which they are mounted, or axially, with alternating polarities, parallel to the axis of the body on which they are mounted, or along a diret rix of the conical surface on which they are fixed.

For completeness, it should be added that the fluid brought into contact with the second element 4a, 4b, 4c, 4d is fed through its pipes by known means, such as pumps.

The device according to the invention works in the following manner.

When the first element 2a, 2b, 2c, 2d is set in motion relative to the second element 4a, 4b, 4c, 4d, the second element is cut by a flux of magnetic induction that varies in time. Because of this fact, an e.m.f. is set up in the second element 4a, 4b, 4c, 4d and, by the Joule effect, heats the second element 4a, 4b, 4c, 4d and the heat generated is extracted from the second element 4a, 4b, 4c, 4d by the fluid or solid which is fed through in contact with the second element. It should be observed that the fluid may be heated in such a way as to bring about its partial or complete vaporization.

The extracted heat can be used directly or converted, in a manner known per se, into mechanical energy.

The fluid brought into contact with the second element 4a, 4b, 4c, 4d may also be contained in vessels or other containers rather than being contained by a tubular pipe.

It has been found in practice that the device according to the invention fully achieves its object in that it converts, in a simple and financially advantageous manner, magnetic energy into thermal energy that can then be used for multiple applications, both residential and industrial.

The device, thus conceived, is open to numerous modifications and variations that all come within the scope of the inventive concept; and, furthermore, all the details can be replaced by other technically equivalent elements.

In practice, there is no restriction on what materials are employed or on the shapes and dimensions of each component part, which will depend on requirements and the state of the art, provided they are compatible with the particular use.

For example, in the illustrative embodiment described earlier and shown in Figure 5, the ferromagnetic element containing the magnets may, without affecting any of the modes of operation already described, be in the shape of a frustum of a cone, rather than a cylinder as depicted, and may face coaxially from the inside towards the conducting element, which in this case would also consist of turns laid out on the surface of a frustum of a cone complementary to the frustum of a cone of the ferromagnetic element. This version, which is not shown in the drawings, may advantageously be adopted where it is wished to have the possibility of rapidly withdrawing the magnets from the turns of the conducting element: the ferromagnetic element would simply be drawn slightly back from the latter to achieve the desired separation, for obvious geometrical reasons.

CLAIMS

1. Device for converting magnetic energy into thermal energy, particularly for heating material in a solid or fluid state, characterized in that it comprises at least one first ferromagnetic element bearing a plurality of high-energy permanent magnets and at least one second element made of an electrically conducting material facing the said first element, drive means being provided to impart a movement to the said first element relative to the said second element or vice versa, and the said high-energy permanent magnets having alternating polarities along the direction of motion of the said first element relative to the said second element or vice versa.

2. Device according to Claim 1, characterized in that it comprises means for conveying at least one heat-transfer fluid or solid in contact with the said second element.

3. Device according to Claim 1 and/or 2, characterized in that the said first element comprises a discoidal body facing the said second element; the said magnets being mounted on that face of the said discoidal body of the first element which is nearest the said second element; the said discoidal body of the first element being capable of being driven with rotational motion about its axis relative to the said second element or vice versa and the said magnets being arranged on the said discoidal body of the first element with alternating polarities along a circumferential path about the axis of the said discoidal body of the first element.

4. Device according to any of the preceding claims, characterized in that the said discoidal body of the first element carries magnets on both of its faces that both face the said second element.

5. Device according to any of the preceding claims, characterized in that the said first element

comprises two coaxial discoidal bodies facing each other, with the said second element between; the said magnets being mounted on those faces of the said discoidal bodies of the first element that are nearest the said second element; the said discoidal bodies of the first element being capable of being driven with rotational motion about their axis relative to the said second element or vice versa and the said magnets being arranged on the said discoidal bodies of the first element with alternating polarities along a circumferential path about the axis of the corresponding discoidal body of the first element.

6. Device according to any of Claims 3 to 5, characterized in that the said magnets are arranged such that their polarities alternate from the centre towards the periphery of the corresponding discoidal body of the first element.

7. Device according to any of the preceding claims, characterized in that the said second element comprises at least one discoidal body facing the discoidal body of the said first element; the said discoidal body of the second element supporting, on its face nearest the said discoidal body of the first element, a pipe for conveying a fluid.

8. Device according to any of the preceding claims, characterized in that the said second element comprises two coaxial discoidal bodies, facing each other with the said discoidal body of the first element between them.

9. Device according to any of the preceding claims, characterized in that the said first element comprises at least one cylindrical body whose side wall is next to the said second element; the said magnets being mounted on the side wall of the said cylindrical body of the first element next to the said second element; the said cylindrical body of the first element being capable of being driven with rotational motion about its axis relative to the said second element or

vice versa and the said magnets being arranged on the said cylindrical body of the first element with alternating polarities along a circumferential path about the axis of the said cylindrical body of the first element.

10. Device according to any of the preceding claims, characterized in that the said first element comprises at least one body shaped as a cone or a truncated cone with its side wall facing the said second element; said magnets being mounted on the side wall of said body of the first element facing the second element, the said body shaped as a cone or a truncated cone of the first element being capable of being driven with rotational motion about its axis relative to the said second element or vice versa, and the said magnets being arranged on the said body shaped as a cone or a truncated cone of the first element with alternating polarities along a circumferential path about the axis of the said body shaped as a cone or a truncated cone of the first element.

11. Device according to any of the preceding claims, characterized by that the said first element is capable to being moved axially with respect to the said second element in order to be inserted into or moved away from it.

12. Device according to any of the preceding claims, characterized in that the said first element comprises at least one internally hollow, basically cylindrical body whose inner and/or outer side wall is next to the said second element; the said magnets being mounted on the side wall of the said cylindrical body of the first element next to the said second element; the said cylindrical body of the first element being capable of being driven with rotational motion about its axis relative to the said second element or vice versa and the said magnets being arranged on the said cylindrical body of the first element with alternating

polarities along a circumferential path about the axis of the said cylindrical body of the first element.

13. Device according to any of the preceding claims, characterized in that the said second element comprises at least one cylindrical body positioned coaxially inside and/or outside the said cylindrical body of the first element.

14. Device according to any of the preceding claims, characterized in that the said cylindrical body of the second element comprises a fluid conveying pipe formed into a coaxial cylinder on the inside or outside of the cylindrical body of the said first element.

15. Device according to any of Claims 9 to 14, characterized in that the said magnets are arranged with alternating polarities in a direction roughly parallel to the axis of the cylindrical body of the said first element, or along a diretrix of the conical surface of the side wall of the body of said first element.

16. Device according to any of the preceding claims, characterized in that the said second element comprises a roughly cylindrical body situated coaxially inside the said cylindrical body of the first element; the cylindrical body of the said second element housing a means of moving a fluid or solid with a component parallel to the axis of the said cylindrical body of the second element.

17. Device according to any of the preceding claims, characterized in that the said first element and the said second element may both be driven with relative motion, one with respect to the other.

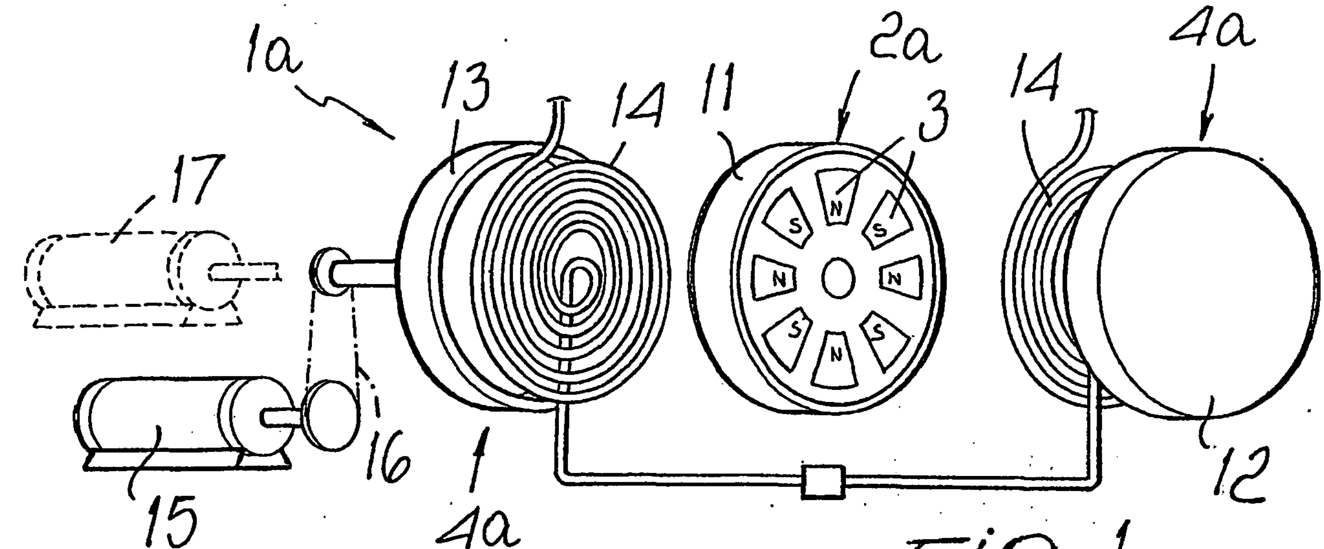


Fig.1

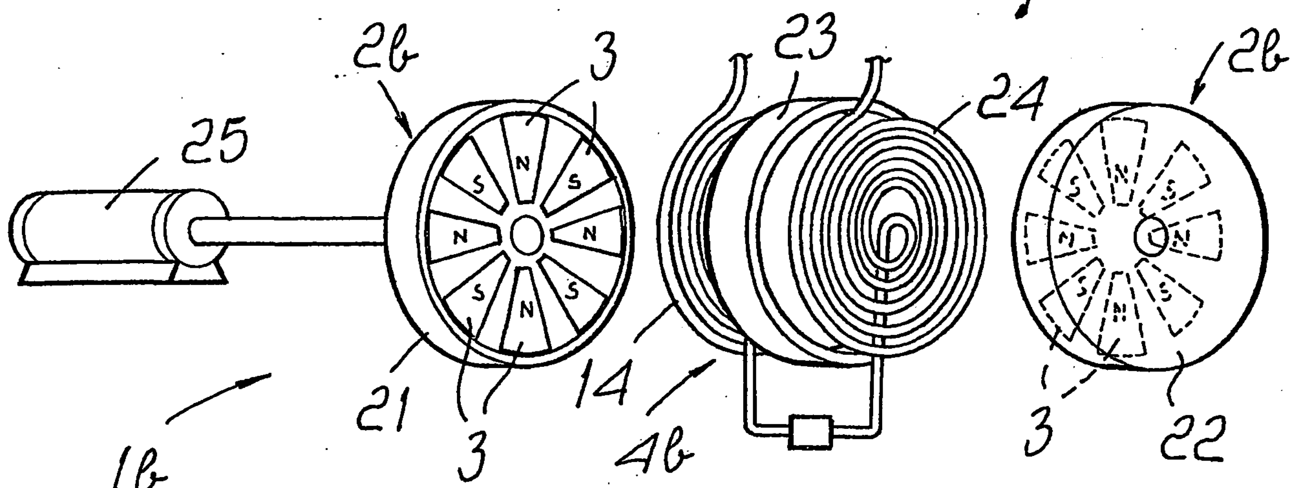


Fig.3

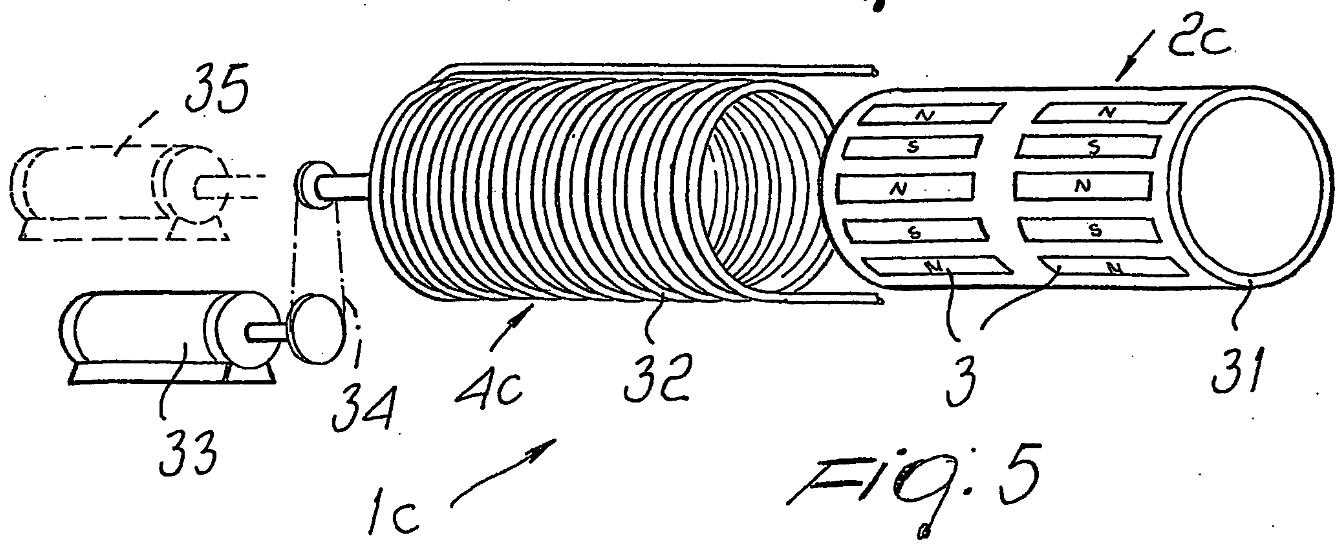


Fig.5

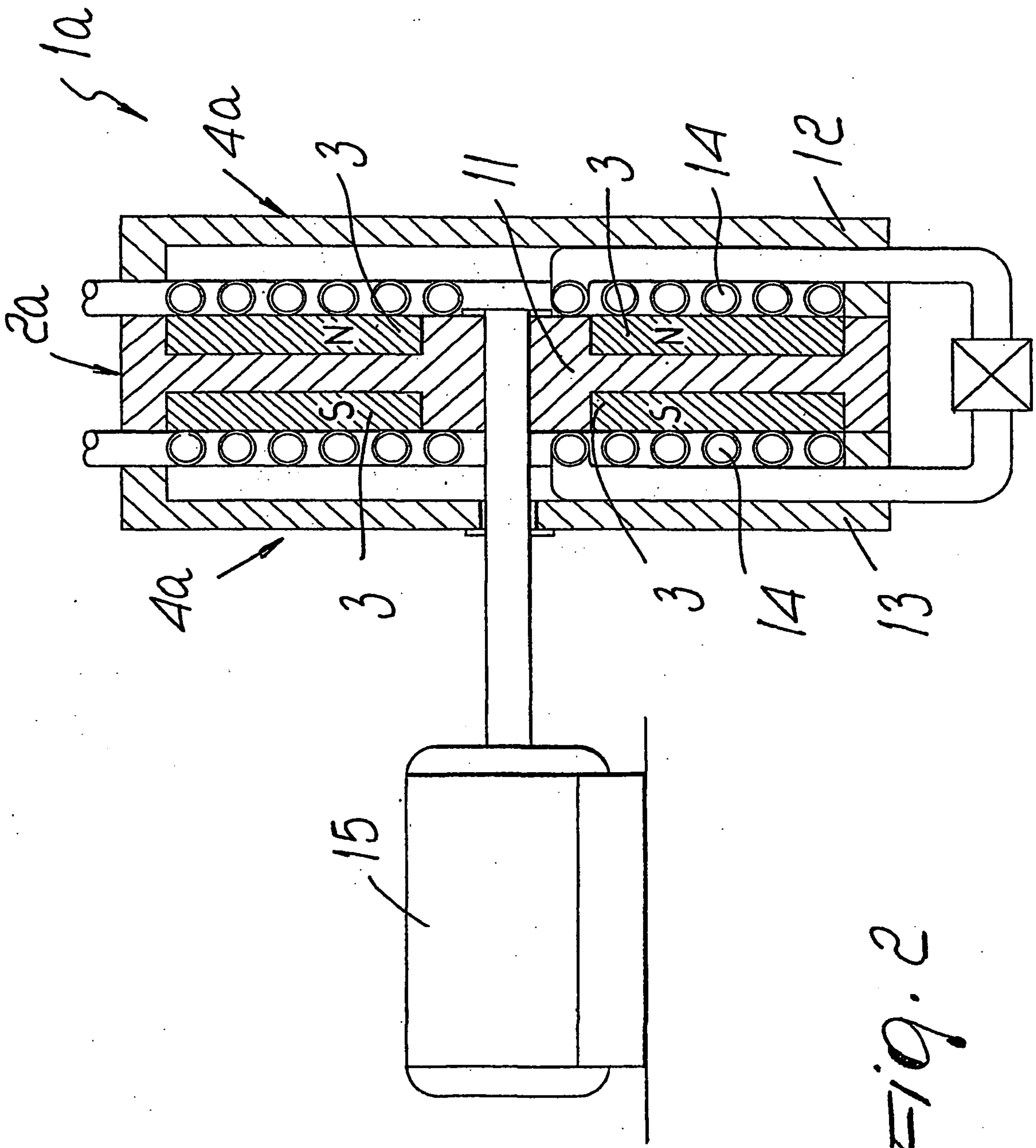


Fig. 2

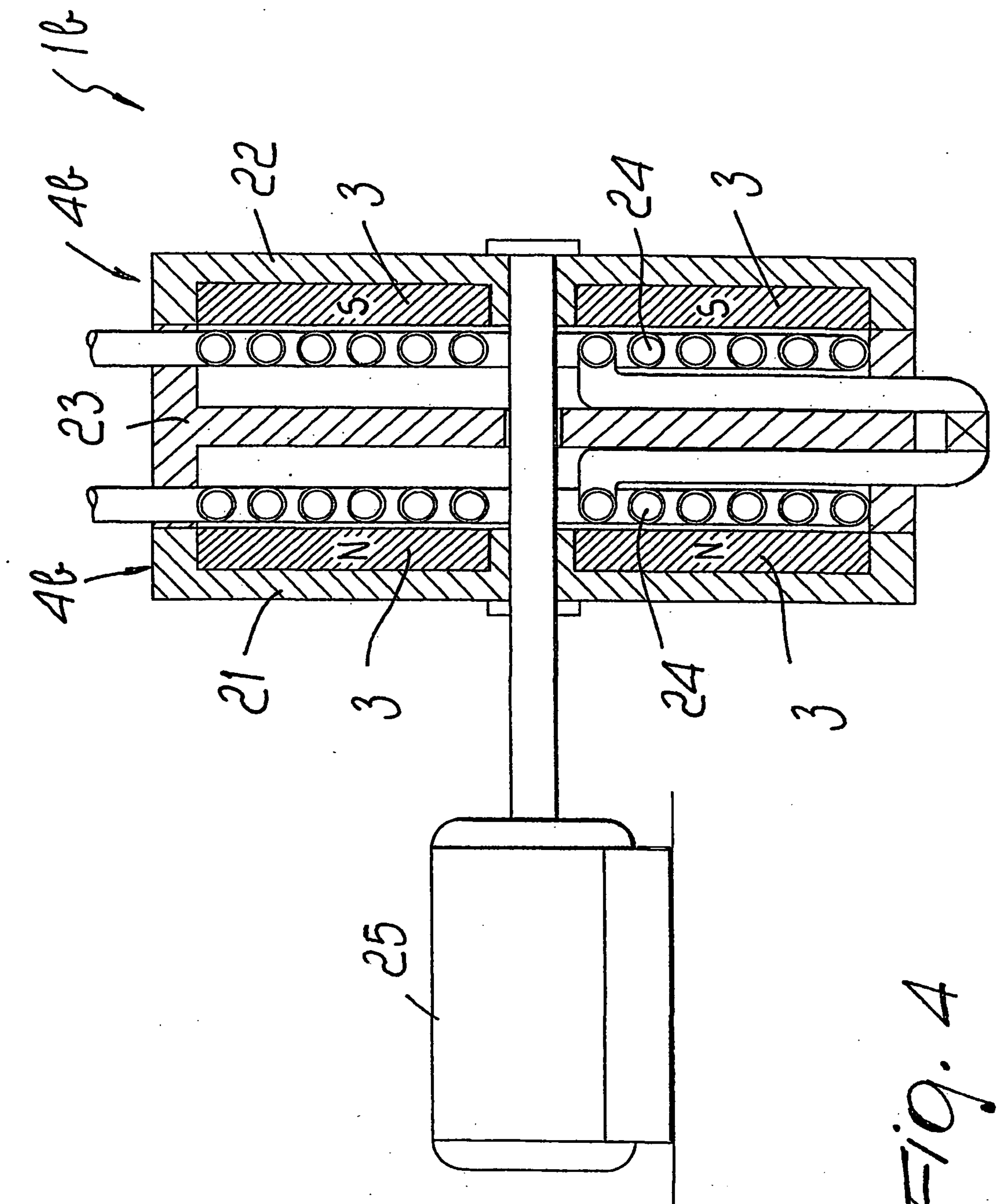


Fig. 4

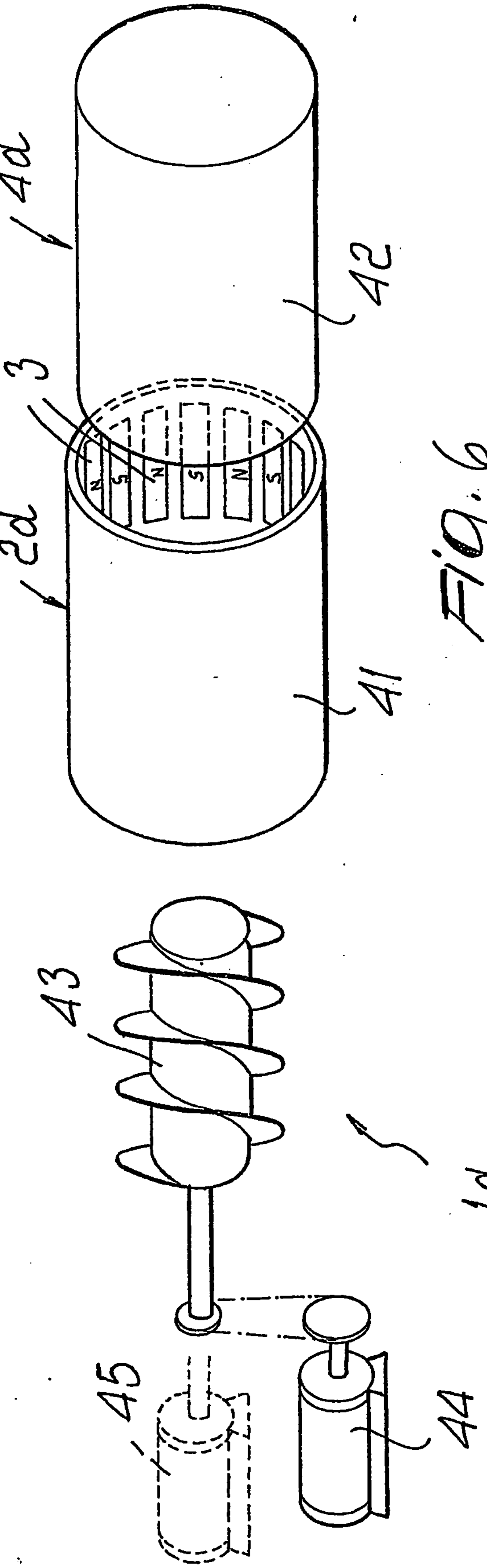


Fig. 6

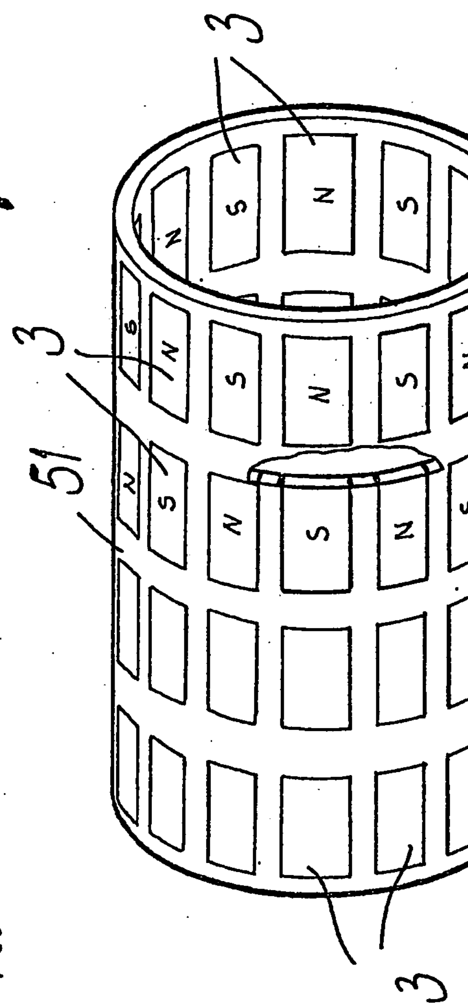


Fig. 7

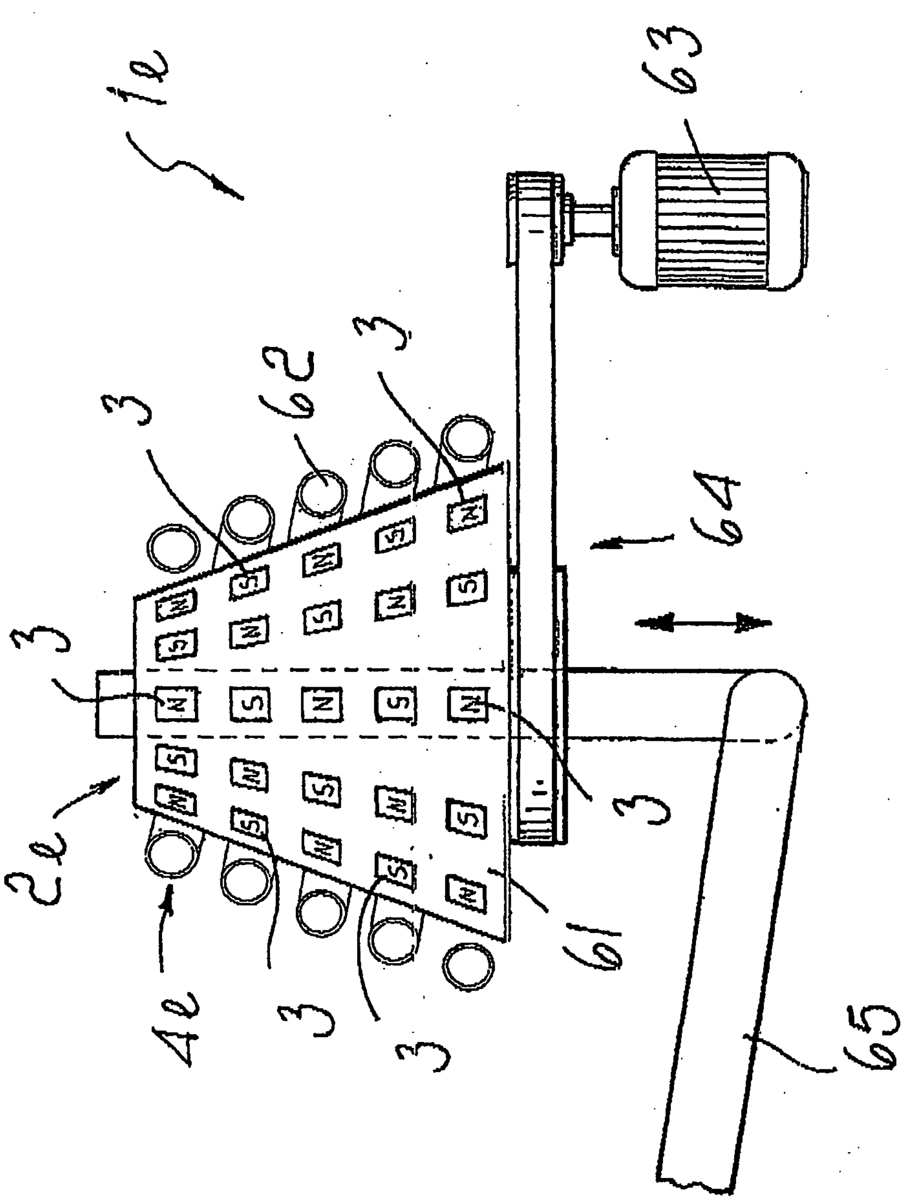


Fig. 8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 02/01301

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B6/02 H05B6/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 914 065 A (ALAVI KAMAL) 22 June 1999 (1999-06-22) abstract column 1, line 55-57 column 5, line 40-43 column 5, line 61 -column 6, line 29 column 6, line 59,60 column 7, line 12-14 column 7, line 43-45 column 8, line 38-65 column 10, line 1-15 figures 1-7 ---	1-3,5,9, 12-14,16

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 June 2002	11/07/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	D/L TASSA LAFOR.., J

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 02/01301

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 511 777 A (GERARD FRANK) 16 April 1985 (1985-04-16) column 1, line 52-56 column 2, line 6-16 column 4, line 19-30 claims 1,5,6 figures 1,4	1,7
A	US 6 144 020 A (INOUE HIROSHI ET AL) 7 November 2000 (2000-11-07) abstract claim 1 figures 1-13	1-15

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No
PCT/IB 02/01301

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5914065	A	22-06-1999	NONE		
US 4511777	A	16-04-1985	NONE		
US 6144020	A	07-11-2000	JP	11329691 A	30-11-1999
			DE	19922223 A1	23-12-1999
			FR	2779025 A1	26-11-1999
			GB	2340549 A	23-02-2000
			SE	9901801 A	20-11-1999